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Assessment of the variations of local parameters of Wetspass model: case study Nile Delta aquifer

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Abstract

Assessment the variation of WetSpass model parameters in the Nile Delta aquifer, Egypt is very significance before applying it to estimate the variations of groundwater recharge from rainfall. The input WetSpass model parameters are investigated based on the soil type, crop classification, and the previous studies. The input model paramters are crop height (h_c), root depth (r_d), Interception percentage (I), leaf area index (LAI), bulk resistance (r_s), roughness length (z) and zero plane displacement (d). The investigation results of this paper indicate that the local model parameters have a great variation. The WetSpass model was calibrated for crop height h_c in a range between 0.4 m to 1.0m. The RMSE between the simulated WetSpass value and the calculated one increased with the increase of h_c. The minimum RMSE equals 8.13 mm/winter season at h_c equals 0.4m. An extensive sensitivity analysis is required for all WetSpass parameters for the accurate determination of the model parameters.

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Keywords: Nile Delta; Groundwater recharge; WetSpass model

1. Introduction

The available groundwater models are used for analysing groundwater systems in both steady state flow and transient flow, so they need average recharge values as input. The WetSpass model can be used to estimate the groundwater recharge from precipitation.

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The WetSpass model is a physically based model was used to estimate the groundwater recharge, surface runoff and actual evapotranspiration [1]. A good understanding of groundwater simulation processes with coupling the WetSpass model with the groundwater flow simulation model-MODFLOW to understand the groundwater flow characteristics, groundwater level variations and the aquifer storage [2]. The estimated output groundwater recharge from WetSpass model can be coupled with steady-state groundwater models. The WetSpass model on its calculation depending on the water balance equations of vegetation surfaces, bare area, open water area and an impervious surface, it was used to estimate the groundwater recharge in Gaza strip [3]. WetSpass model was used to estimate the variation of groundwater recharge from rainfall in Gaza, Palestine. The WetSpass hydrological model was copuled with (MODFLOW) groundwater model to determine the efect of groundwater recharge variation on the groundwater level. The water table level was predicted with different climate change scenarios which include a variation of recharge and precipitation [4] and [5].

In India, the effects of variations of land-use on the water regime were stuided by using the WetSpass model. The model was integrated into the ArcView in GIS, it was extremely flexible and allowed an easy definition of man-made or natural land-use types [6]. The crop growth water deficit, the coefficient of surface runoff and cumulative runoff volume in the Geba basin, Northern Ethiopia were determined by using WetSpass model due to the estimated variations of groundwater recharge, [7] and [8]. The average rainfall, in Egypt, in the Nile delta region was reported that is very small and ranges between 25mm/year in the South near to Cairo and 200mm/year in the North near to the Mediterranean Sea [9]. The groundwater recharge from rainfall in the Nile Delta was neglected in pervious groundwater modeling studies [10]. The investigation of variations of groundwater recharge in the Nile Delta aquifer is quite important for accuarte simulation and representaion of groundwater modeling problems. This paper comes online to investigate the variations of WetSpass input model parameters to find the suitable range of the Nile Delta region for each parameter.

2. Study area description

The Nile Delta, along with its fringes, occupies an area of 24.000 km^2. It lies between latitudes 31^o 35' 0.0" and 31^o 35' 0.0" North and longitudes 29^o 45' 0.0" and 32^o 20' 0.0" East and at a distance of 20 km north-west of Cairo (Delta Barrage). The Nile Valley alluvial delta has a base length of 275 km along the Mediterranean Sea between Alexandria and Port-Said [11], as shown in Figure 1. Figure 1 shows the location of the Nile Delta and the locations of data collection stations.

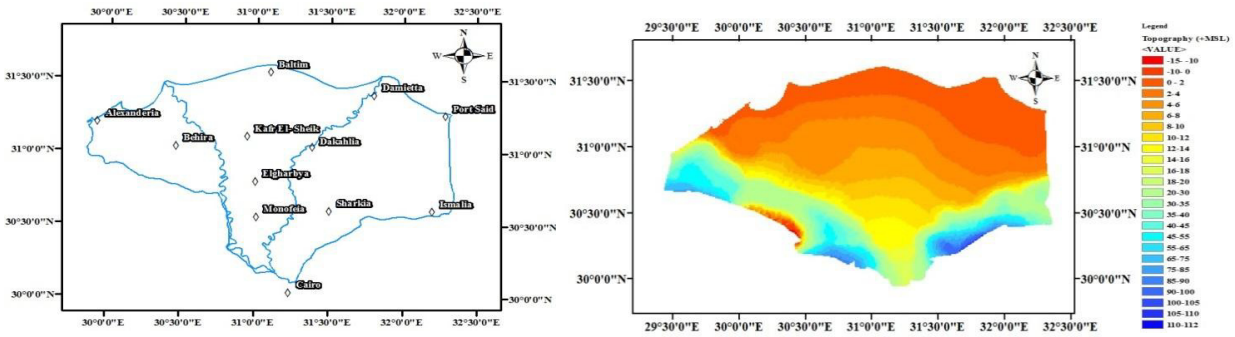

Fig.1. Nile Delta, location of data collection and topography map

3. WetSpass model parameters

The WetSpass model parameters are related to the crops classification in the Nile Delta region. Respecting to the Ministry of Agriculture and Reclamation Lands of Egypt, the Wheat, Bean, Barseem and Sugar cane are most common crops in the Nile Delta. The classification of crops in the different governorates in the Nile Delta region are summarized in Table 1, according to [12]. The total percentage of wheat cultivation area is 1690056 fadden, about